Senior Thesis

Hydrogeologic Study of an Industrial Site Near Hebron, Ohio

By
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Approved by:

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1. INTRODUCTION

This paper deals with a hydrogeologic study of a contaminated industrial site near Hebron, Ohio. The goal of this study is to describe the regional hydrogeology in Licking County and the hydrogeologic setting of a study site in Hebron, Ohio. This paper will also look at how the local hydrogeology at the study site affects the movement of contaminants.

The consulting firm that was hired to do the original study employs the author. The author participated in the gathering of portions the data used in the original study. The study was prepared for the company that owns and wishes to sell the study site, the Ohio EPA, and one other consulting firm that was hired by the company that wishes to purchase the property. The report was submitted in December 1998. The main focus of my work here is to provide a more general look at the contamination in relation to the hydrogeological setting.

1.1 BACKGROUND

A study was completed on the site in Hebron by an environmental consulting firm in late 1997 through the later part of 1998. The study was designed to look at the extent of soil and groundwater contamination due to industrial practices. The site was also being reviewed for the Ohio Environmental Protection Agency's Voluntary Action Program (VAP). This program allows property owners, lenders and developers to investigate and cleanup contaminated properties without direct oversight from the Ohio EPA. If the cleanup is done according to standards set forth by the Voluntary Action Program rules, the Ohio EPA will issue a covenant not to sue, releasing the owner from state civil liability. There is more information available on the VAP at the Ohio EPA website (http://www.epa.ohio.gov/derr/vap/aboutvap/aboutvap.html).

2. PHYSICAL SETTING

2.1 LOCATION, TOPOGRAPHY AND DRAINAGE

The study site for this paper is located in Hebron, Ohio (Fig. 1). The Village of Hebron is approximately 42 kilometers east of Columbus, Ohio in Union Township, which is in southern Licking County. The site consists of a 6.1-acre parcel of land in an industrial complex near Hebron. A manufacturing plant and small pretreatment building are located on the site (Fig. 2). The plant currently manufactures corrugated paper and cardboard boxes. The pretreatment building is no longer in use. There is a railroad bordering the site to the west. The South Fork Licking River borders the property to the east.

A 1.07-meter storm drain collects storm runoff from the site. The storm-drain transverses the southern part of the property from west to east (Fig. 2). Surface runoff from a concrete pad along the West Side of the building infiltrates into the ground along the edge of the pad. Excess storm runoff flows into a drainage ditch that conveys the runoff to the storm drain. The storm drain eventually drains to a larger drainage ditch that finally empties into The South Fork Licking River to the east of the plant.

Licking County is in two physiographic provinces. The western two-thirds lies on the eastern edge of the Central Lowlands Province and the other third is part of the

Allegheny Plateau. The site is developed on a Wisconsin glacial till plain of the Central Lowland province of the United States. Elevations in Licking County range from approximately 414.5 meters above sea level to approximately about 225.5 meters above sea level. The highest elevation occurs in Liberty Township, which is northwest of Hebron. The lowest elevation occurs in Hanover Township, which is northeast of Hebron. In the far western part of the county and in the southern part west of Buckeye Lake, the land surface is nearly level and gently sloping. Topography throughout the west-central part of the county is gently undulating and rolling on the glacial moraines and moderately steep, to very steep along dissected valleys and the bedrock-controlled hills northeast of Granville. The eastern part of the county, or the plateau section, has hilly topography with local relief of about 60 meters between ridgetops and flood plains.

The Licking River is the principal stream in Licking County. It forms as the North Fork Licking River, the South Fork Licking River and Raccoon Creek join in Newark, near the center of the county. The Licking River and its tributaries drain most of Licking County. The northeastern part of the county, however, is drained by Wakatomika Creek. Tributaries of Jonathan Creek drain the southeastern part. These streams are part of the Muskingum River drainage basin. A portion of western Licking county is drained by tributaries of Big Walnut Creek and Little Walnut Creek, which are part of the Scioto River drainage basin. Figure 3 shows drainage and relief in Licking County.

2.2 REGIONAL GEOLOGY

Near surface bedrock, underlying Licking County, consists of sandstone, siltstone and shale. These rocks are horizontally bedded and dip slightly to the east. The bedrock is

Mississippian in age, consisting of the Logan, Cuyahoga, Sunbury Shale, Berea Sandstone and Bedford Shale formations. Bedrock on the Allegheny Plateau consists of the Mississippian age Logan Formation and the Pennsylvanian age Pottsville and Allegheny Groups. Underlying the hills on the western edge of the Allegheny Plateau are mainly siltstones and fine-grained sandstones of the Logan Formation. These formations dip slightly to the southeast and dip beneath younger formations to the east.

Licking County has been glaciated at least twice in the last 350,000 years. The first of these episodes was the Illinoian glaciation, which covered much of the county except for the eastern portion. The second major advance, the Wisconsinan, did not extend as far east as the Illinoian. The Illinoian glaciation is thought to have taken place between 132,000 and 302,000 years ago and the Wisconsinan about 20,000 years ago. The thickness of glacial drift in the portion of the county exposed to glaciation ranges from a few centimeters to more than 30 meters. Some locations in the county are not covered by drift. In some cases, there was no deposition and in other cases, those deposits have since been eroded. The drift in Licking County comes from local sandstone and shale; from the limestone, dolomite and shale in central and northern Ohio; and from the granite, quartzite and other crystalline rocks on the Canadian Highlands.

Ground moraine in the Central Lowlands Province has a smooth surface with little topographic expression. Most of the glacial drift on the Allegheny Plateau tends to follow the topography of the bedrock. Many of the end moraines are continuous along the former ice front, but streams have cut through some. Many places in the county contain lacustrine deposits that formed in ponds and lakes. These water bodies were the result of glacial meltwater in periods of relatively warm weather. Outwash sands and gravels occur in the major valleys draining meltwater from both the Illinoian and Wisconsinan glaciers. Where the Wisconsinan glacier overran the earlier Illinoian deposits, the Illinoian deposits were either covered or destroyed. The main deposit of Wisconsinan outwash is in the large valleys along the Licking River and its tributaries.

2.3 SITE GEOLOGY

The site itself is underlain by Wisconsin-Age ground moraine. Sand and gravel outwash with interbedded clay lenses underlies the ground moraine. The soil profile above the sand and gravel aquifer is predominantly glacial clay with thin sand lenses.

It is possible to subdivide the till units. The upper portion consists of a yellowish-brown oxidized till layer, which overlies a dark gray unoxidized till. The yellowish-brown till extends downward to approximately 3.5 meters below the surface. A thin silty sand zone separates the yellowish-brown till from the dark gray till layer, suggesting that it is a separate till unit. The dark gray unoxidized till extends down to approximately 7.5 meters below the surface. Outwash sands and gravels occur between 9 and 12 meters below the surface. A series of two to three clay lenses are present in the outwash at depths between 12 meters and 16 meters. These units are likely tills and probably represent local glacial advances. The stratum is consistently sand and gravel from 16 meters to 35 meters below surface grade.

The information on which this geologic description is developed comes from soil bores made while installing monitoring wells on the site, from natural gamma ray logs made through the casings of these monitoring wells and from logs of two non-active production wells at the site. There was also exploratory drilling at locations where monitoring wells were not installed. The locations of the wells and exploratory holes are shown in Figure 4. Figure 5 is a geologic cross section through the site. Figures 6 through 11 show wells logs made from the soil bores.

2.4 GROUND WATER RESOURCES

Glacial till, outwash deposits and bedrock all provide Licking County with potential ground-water supplies. In some cases supplies may be only adequate for domestic use. More permeable units can supply enough water for municipal use.

Glacial till deposits have a low permeability due to the clay and silt components. Thus, very few wells are drilled to extract water from till deposits. Wells that do produce water from these glacial till deposits usually bottom out in thin water-laid gravel and sand deposits. These gravel and sand deposits are probably the result of deposition by meltwater streams that were present under the ice sheets. These gravel and sands are generally small in extent and thickness, and are recharged by slow percolation of water through the surrounding till deposits. Wells that are completed in these gravel and sand deposits are adequate for domestic supplies.

Outwash deposits are present as valley trains and outwash plains. The valley train deposits are the major source of ground water for Licking County. Wells completed in these outwash deposits can produce as much as 1135 cubic meters per day. The city of Granville was pumping at this rate in the 1960's. The well is present in the in the outwash gravel and sands along Raccoon Creek. These outwash gravels and sands are open to recharge by river infiltration.

Bedrock formations are another important source of ground water in Licking County. The Pennsylvanian formations in most of Licking County are present only above the water table. These formations include the Allegheny and Pottsville. Pennsylvanian rocks do however provided small amounts of water from the sandstones present in the eastern portion of the county.

The Mississippian formations present in Licking County include the Logan, Cuyahoga, Sunbury Shale, Berea Sandstone and the Bedford Shale. The Bedford Shale and Sunbury Shale are not sources of water in Licking County. The three remaining formations of Mississippian bedrock all produce adequate amounts of water for use in the county. The Logan formation produces average yields of approximately 55 cubic meters per day. In areas where the Logan Formation is too thin, wells are completed in the Cuyahoga Formation. The Cuyahoga Formation supplies the most water of any of the Mississippian Formations. The Cuyahoga Formation yields approximately 27 cubic meters per day to 545 cubic meters per day. The Berea Sandstone produces water that is adequate for domestic and farm use. In Hebron, Ohio most of the water production is from the outwash gravels and sands that were discussed earlier in this paper.

3. Hydrogeology of the Site

Slug test analyses were completed in March of 1998 to determine the hydraulic conductivities of monitoring wells. PW-1 and PW-2, developed in the lower sand and gravel aquifer, were tested with a falling head method. Two gallons of water were added to each well for this test. MW-1 through MW-6 were slug tested using a rising head method. Water was bailed with a 2-inch diameter PVC bailer for this test.

The data for these tests were collected with an In-Situ, Inc. Troll Model SP400 down hole datalogger/transducer. In-Situ Inc. software, Win-Situ, was used to acquire and manage data received from the Troll. The results from the slug testing at the site are shown in Table 1. Laboratory values for certain samples have been shown in the table also.

TABLE 1. SUMMARY OF SLUG TEST DATA.

WELL NUMBER	FIELD VALUE K (cm/s)	LAB VALUES K (cm/s)	LAYER COMPLETED IN
MW-1	1.08×10^{-10}		GRAY TILL
MW-2	4.63×10^{-09}	1.50×10^{-07}	YELLOWISH-BROWN TILL
MW-3	5.12×10^{-07}		GRAY TILL
MW-4	4.95×10^{-09}		YELLOWISH-BROWN TILL
MW-5	1.66×10^{-10}	4.50×10^{-08}	GRAY TILL
MW-6	2.95×10^{-09}	4.10×10^{-06}	YELLOWISH-BROWN TILL
PW-1	1.30×10^{-05}		LOWER SAND AND GRAVEL AQUIFER
PW-2	1.09×10^{-06}		LOWER SAND AND GRAVEL AQUIFER

MW-1, MW-3 and MW-5, developed in the lower gray till, have hydraulic conductivity (K) values that differ by an order of magnitude. The geometric mean hydraulic conductivity for the gray till layer was determined as follows:

$$K = \{[(1.08 \times 10^{-10}\ \text{cm/s})(5.12 \times 10^{-7}\ \text{cm/s})(1.66 \times 10^{-10}\ \text{cm/s})]\}^{1/3}$$

$$K = 2.09 \times 10^{-9}\ \text{cm/s}$$

This calculation gave the following value for the lower sand and gravel aquifer.

$$K = \{[(1.30 \times 10^{-5}\ \text{cm/s})(1.09 \times 10^{-6}\ \text{cm/s})]\}^{1/2}$$

$$K = 3.76 \times 10^{-6}\ \text{cm/s}$$

The mean hydraulic conductivity for the yellowish-brown till layer was:

$$K = \{[(4.63\text{x}10^{-9}\ \text{cm/s}) + (4.95\text{x}10^{-9}\ \text{cm/s}) + (2.95\text{x}10^{-9}\ \text{cm/s})/(3)]\}$$

$$K = 4.18\text{x}10^{-9}\ \text{cm/s}$$

These values are typical of these deposits in Ohio. They indicate that the upper units generally have a low hydraulic conductivity. Even the aquifer present at this site has a low hydraulic conductivity.

4. CONTAMINATION

Low level VOC contamination was discovered across the study area to a depth of 3.6 meters in the soil. Figures 12 and 13 show a planar view of how 1,1 dichloroethane and 1,1,1 trichloroethane are distributed across the site. Figures 14 and 15 show how these two contaminants look as a function of depth at the site. The 1,1 dichloroethane is spread laterally across the site along a distance of approximately 60 meters and extends to a depth of approximately 4 meters. The 1,1,1 trichloroethane is spread laterally across the site along a distance of approximately 24 meters. The 1,1,1 trichloroethane extends to a depth of approximately 4 meters. It is thought that the 13 feet of stiff glacial till that separates the VOCs from the water table will further reduce the concentration below EPA standards. The water table is located approximately 7.6 meters below the surface.

Site specific geophysical and chemical data was input to a calibrated SESOIL model. Of the 16 detected VOCs in the subsurface, SESOIL indicates that only three, 1,1,1–Trichloroethane, 1,2-Dichloroethane and Methylene Chloride have the potential to reach the water table at concentrations above Ohio EPA standards. Based on the modeling done by the consulting firm hired to do the original study, 1,2-dichloroethane will reach the water table in 23.3 years, 1,1,2-trichloroethane in 48.3 years and methylene chloride in 16.7 years. These times as predicted by the SESOIL model do not account for ion exchange and decay adequately. Table 2 (pg.14) is a list of the VOCs found at the site and the Ohio EPA recommendation for dealing with that contaminant.

4.1 BIODEGRADATION OF CONTAMINANTS

The contaminants, which are listed on Table 2, are all found in the oxidized yellowish-brown till layer across the site. The contaminants extend to a depth of approximately 4 meters below the surface. Because the mineral constituents of the layer have already been oxidized, the continuing infiltration of oxygen creates an aerobic environment in which bacteria can live and break down some contaminants that may be present in the layer. This natural attenuation is important to this site because the consulting firm hired to do the study and the Ohio EPA have determined that no further action needs to be taken at this site. At the study site, the layer that is contaminated is a clayey sediment, which will inhibit bacterial colonies from forming in large numbers. However, the bacteria present will still have some impact on the way these contaminants migrate in the subsurface. The contaminants present fall into three basic categories and their susceptibility to breakdown by bacteria will be based on that category. The three categories present are hydrocarbons and their derivatives, halogenated aliphatics and halogenated aromatics.

Hydrocarbons and their derivatives are readily broken down in both aerobic and anaerobic environments. They serve as a primary substrate for bacteria and will be broken down rapidly. One exception to this is ethylbenzene, which in tests has proven somewhat resistant to biodegradation. Halogenated aliphatic compounds are much more resistant to bacterial break down in aerobic settings. They may be broken down as a secondary substrate, because they do not produce enough energy for the bacteria to use when broken down, but this is not likely in this setting. They can, however, be broken down more readily in anaerobic conditions. In the oxidized till layer they will not be readily broken down because it is an aerobic environment with a limited bacterial population. Halogenated aromatics will degrade under aerobic conditions. Table 3 (pg. 15) shows each contaminant, the category it belongs to and its susceptibility to degradation by bacteria.

5. CONCLUSION

The study site is an industrial site underlain by low permeability units. These units hamper the mobility of contaminants located at the site. The low mobility means that many of the contaminants will not reach the water table. Those contaminants that do have the mobility to reach the water table will do so at levels below Ohio EPA standards. This feature is due to retardation of contaminants and to natural biodegradation of the contaminants. Based on the favorable setting and the lack of contaminant mobility, the Ohio EPA and the consulting firm hired to do the study have agreed that under the Voluntary Action Program no further action is needed at the site.

TABLE 2

List of contaminants found at the site and proposed clean up remedy.

Contaminant	Location (Well No./Depth Interval)	Maximum Concentration	EPA Recommendation
Xylenes	*SB-9,SB-11,SB-18	0.033 mg/kg	Cleanup not required
Tetrachloroethene	SB-16/0.3m-0.6m SB-9/2.4meters	0.053 mg/kg	Cleanup not required
1,1-Dichloroethene	**MW-3,SB-7, ***SS3/4.2mSB-16	0.033 mg/kg	Cleanup not required
Ethylbenzene	SB-9	0.008 mg/kg	Cleanup not required
Toluene	SB-11	0.007 mg/kg	Cleanup not required
CIS-1,2-Dichloroethane	SB-7, SB-8	0.058 mg/kg	Cleanup not required
Acetone	SB-1/0.6 m SB-8/0.6m & 1.8 meters	0.17 PPM	Cleanup not required
Trichloroethene	SB-7, SB-9, SB-11	0.081 PPM	Cleanup not required
Isopropylbenzene	MW-3	0.022	Cleanup not required
Dichloro-difluoromethane	SS-1, SS-2, SS-3, SS-4, SS-5, SB-15, SB-16, SB-17, SB-18	.099 PPM	Cleanup not required
Chloroethane	MW-1, SB-7	0.16 PPM	Cleanup not required
1,1,1-Trichloroethane	MW-3,MW-5,SB-7, SB-11,SS-2, SS-3,SS-5,SB-16, SB-18	0.62 PPM	Cleanup not required
1,1-Dichloroethane	MW-1, MW-3, MW-5,SB-7,SB-11, SS-1,SS-2, SS-3, SS-5, SB-16, SB-18	0.54 PPM	Cleanup not required
1,2-Dichloroethane	SS-5, SB-16	.08 PPM	Cleanup is indicated
1,1,2-Trichloroethane	SS-3, SB-16, SB-18	.084 PPM	Cleanup is indicated
Dichloromethane	SB-7, Sb-8, SS-5, SB-15	0.036 PPM	Cleanup is indicated

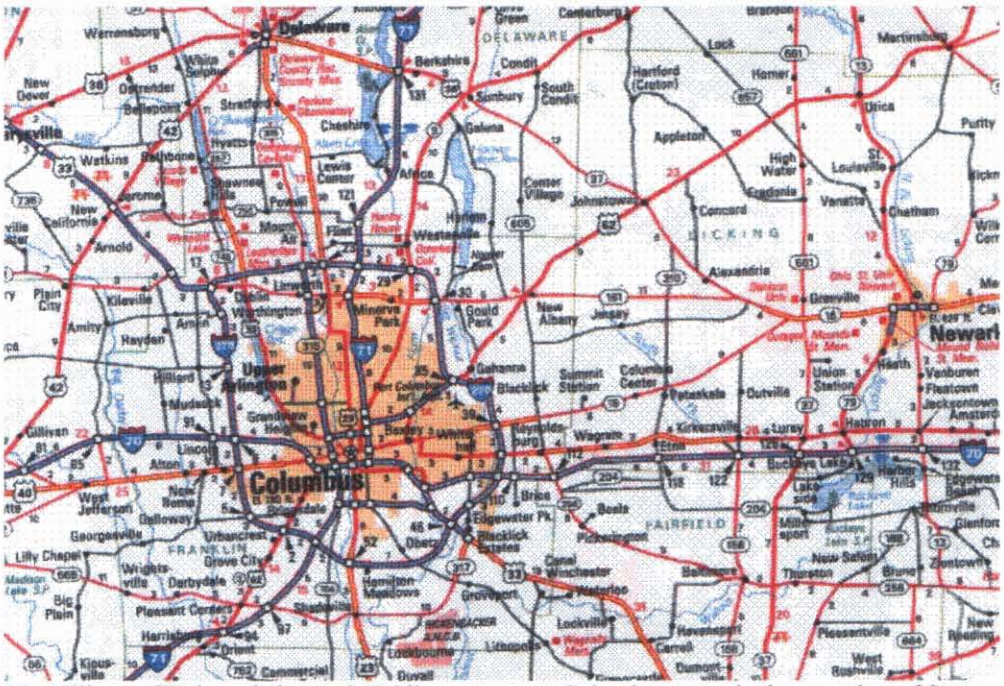
*SB is for Soil Bores done where monitoring wells were not placed **MW is used for samples taken while developing monitoring wells ***SS is used for soil bores located along the storm sewer on the property

Table 3
Tendency for contaminants to be biodegraded at the site.

Contaminant	Chemical Family	Degraded in Aerobic Environment
Xylenes	Hydrocarbons and their Derivatives	Readily
Tetrachloroethene	Halogenated Aliphatics	Not Readily
1,1-Dichloroethene	Halogenated Aliphatics	Not Readily
Ethylbenzene	Hydrocarbons and their Derivatives	Readily
Toluene	Hydrocarbons and their Derivatives	Readily
CIS-1,2-Dichloroethane	Halogenated Aliphatics	Not Readily
Acetone	Hydrocarbons and their Derivatives	Readily
Trichloroethene	Halogenated Aliphatics	Not Readily
Isopropylbenzene	Halogenated Aromatics	Not Readily
Dichloro-difluoromethane	Halogenated Aliphatics	Not Readily
Chloroethane	Halogenated Aliphatics	Not Readily
1,1,1-Trichloroethane	Halogenated Aliphatics	Not Readily
1,1-Dichloroethane	Halogenated Aliphatics	Not Readily
1,2-Dichloroethane	Halogenated Aliphatics	Not Readily
1,1,2-Trichloroethane	Halogenated Aliphatics	Not Readily
Dichloromethane	Halogenated Aliphatics	Not Readily

6. FIGURES

LOCATION MAP



The Village of Hebron is located 42 kilometers east Columbus near the intersection of State Route 79 and State Route 40

FIGURE 1

SITE MAP

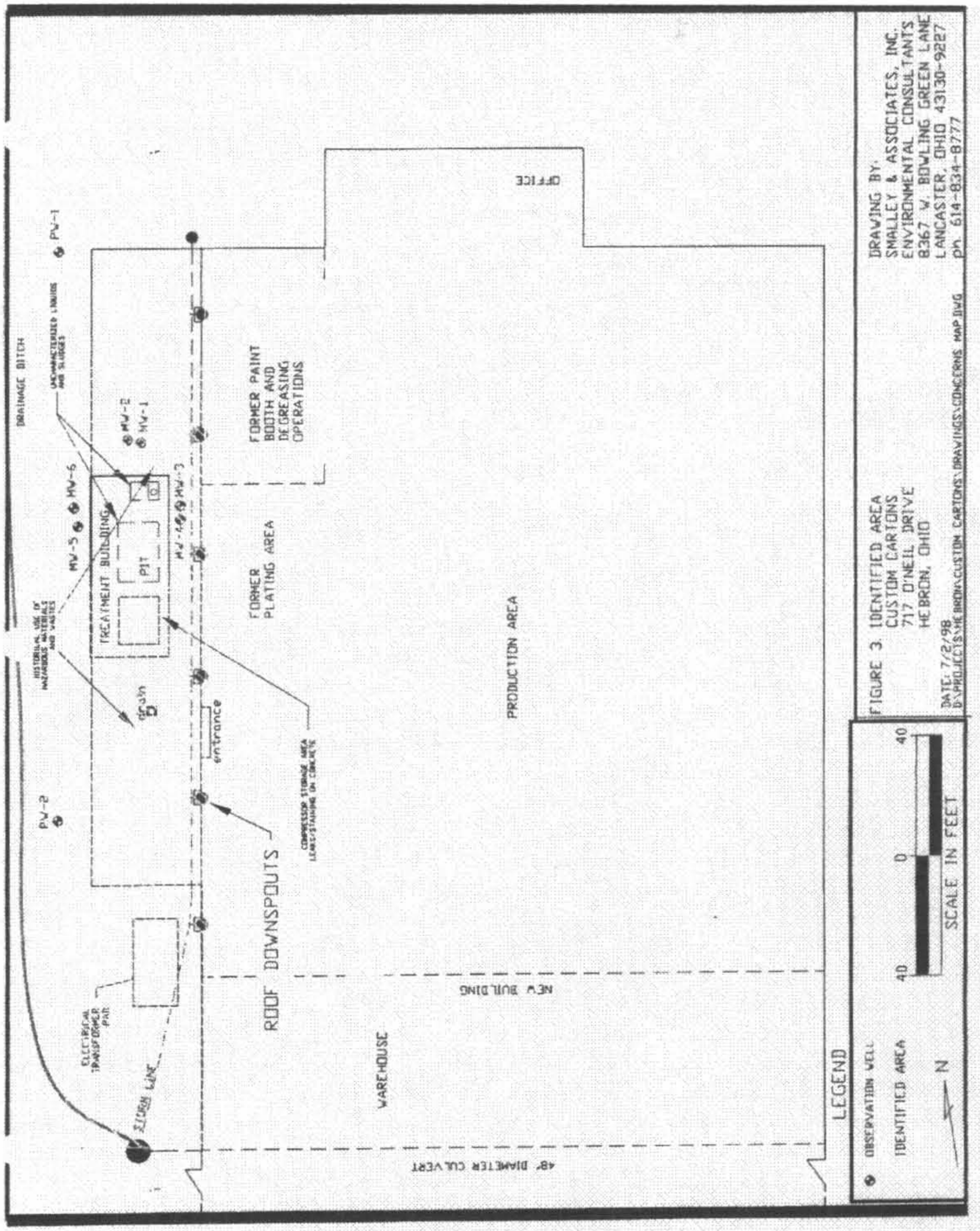
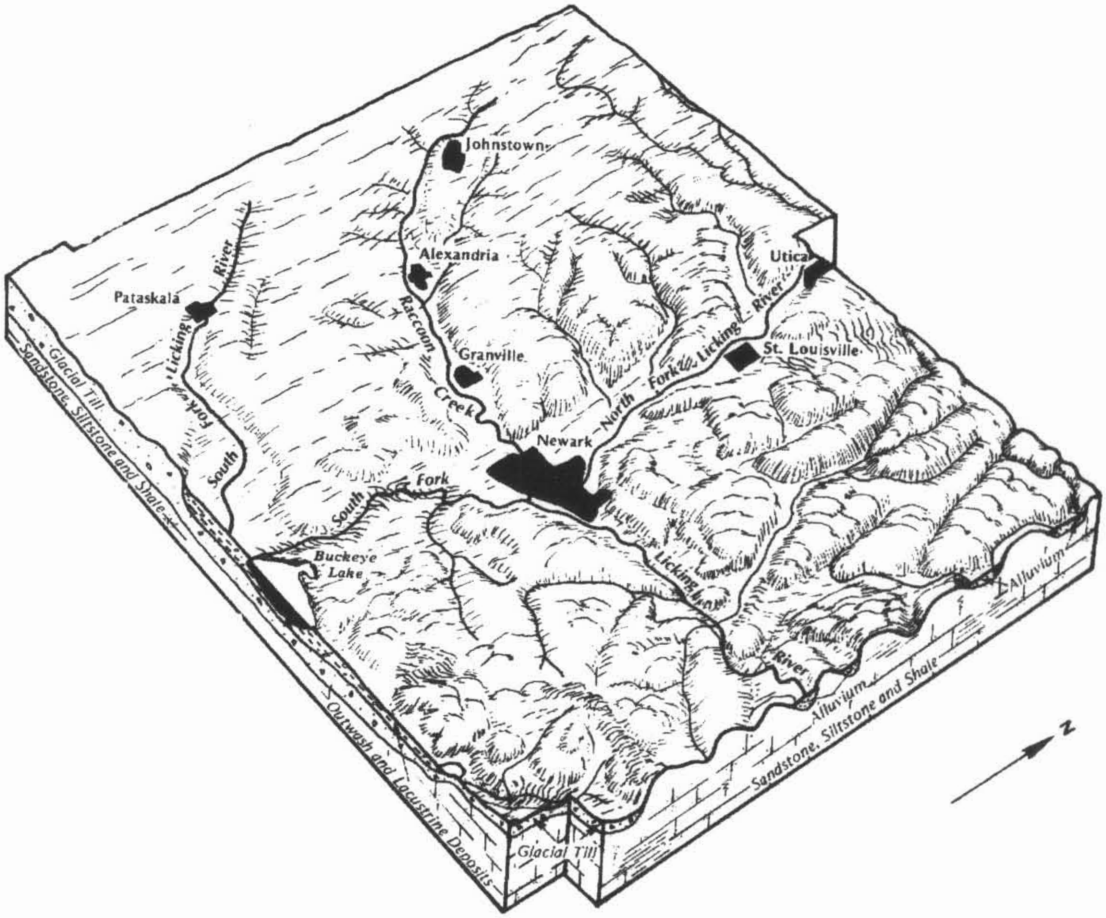


FIGURE 2



Drainage, relief, and parent material in Licking County, Ohio.

FIGURE 3

SITE MAP 2

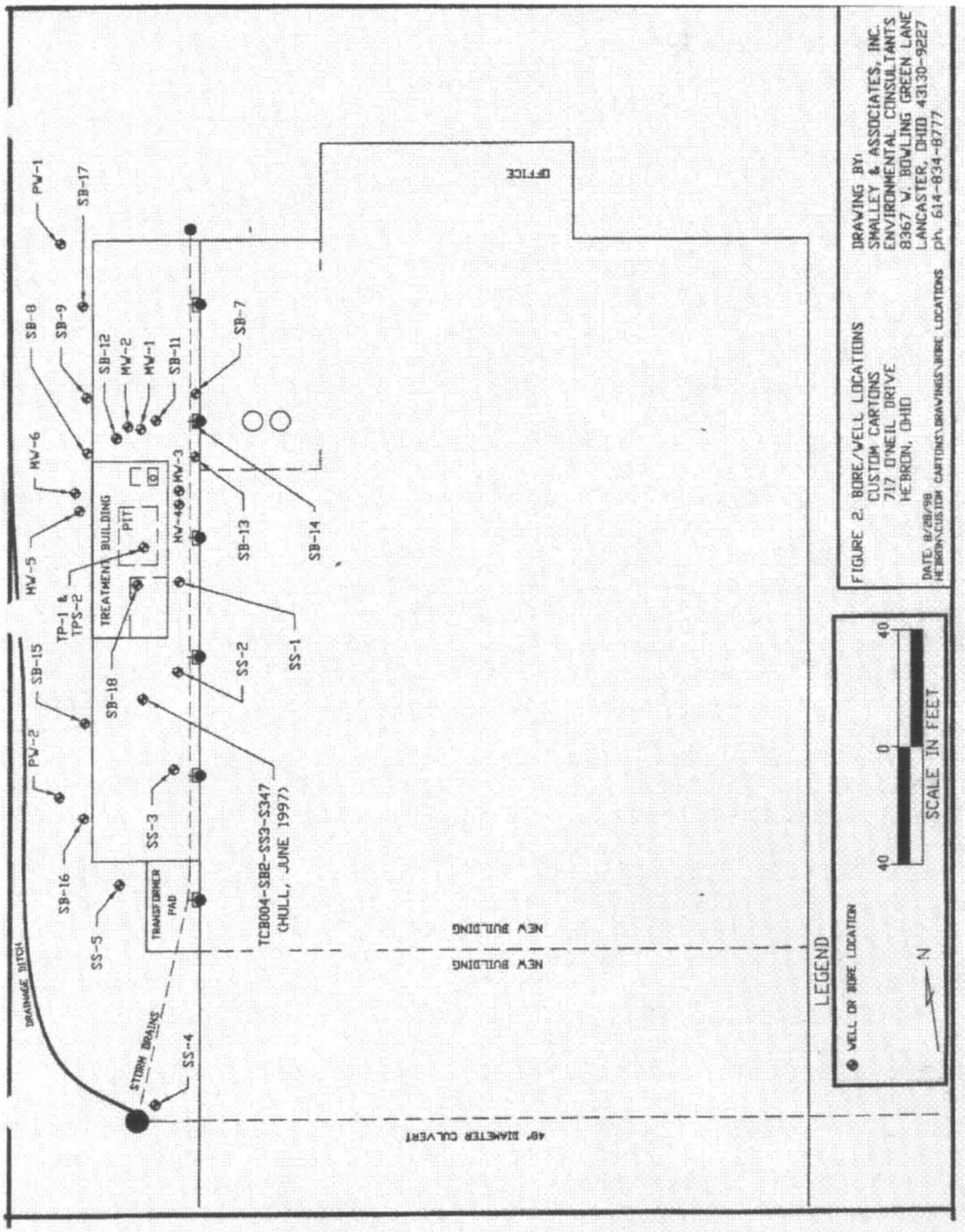


FIGURE 4

CROSS SECTION

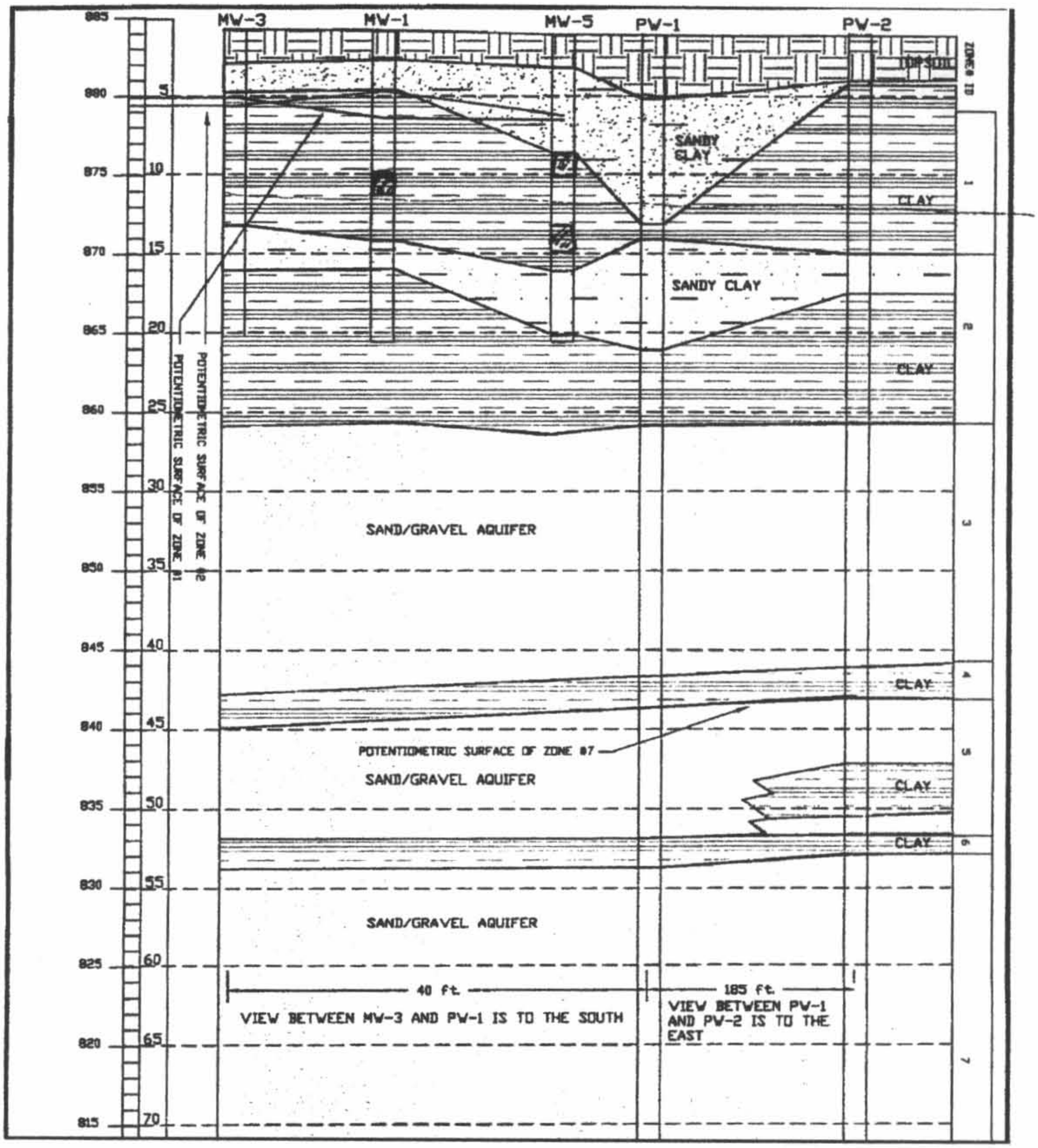


FIGURE 5

MW-1

Geologist	DENNIS SMALLEY	Ground Elevation	884.29 Feet
Date Drilled	12-13-97	Total Depth of Borehole	20.7 Feet
Borehole Diameter	6.25 Inches	Depth to Water	5 Feet

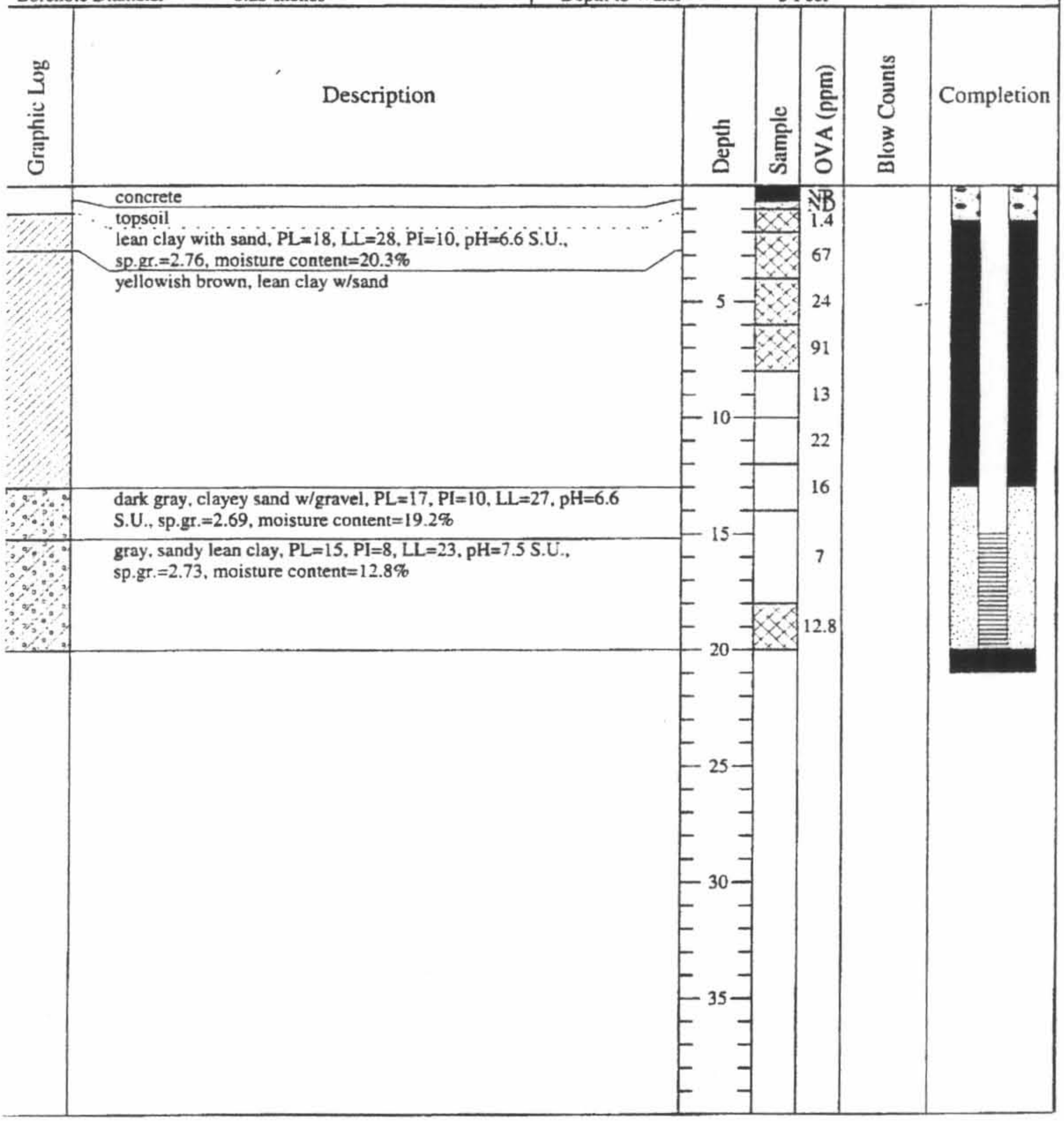


FIGURE 6

MW-2

Geologist	DENNIS SMALLEY	Ground Elevation	884.23 Feet
Date Drilled	12-13-97	Total Depth of Borehole	11 Feet
Borehole Diameter	6.25 Inches	Depth to Water	5 Feet

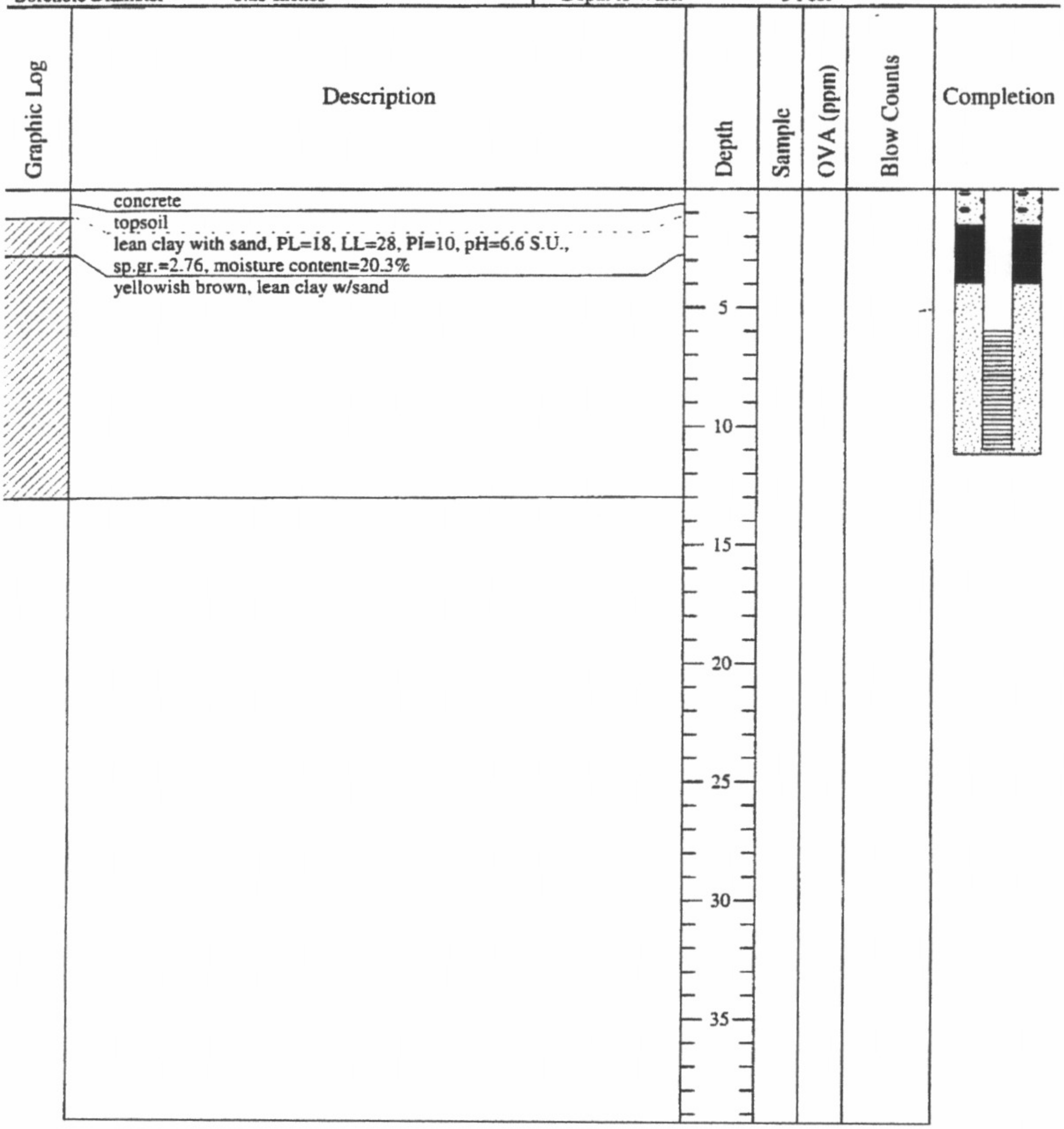


FIGURE 7

MW-4

Project Number	CC121397-45	Drill Rig	CME MODEL 45C
Geologist	DENNIS SMALLEY	Ground Elevation	884.36 Feet
Date Drilled	12-13-97	Total Depth of Borehole	12 Feet
Borehole Diameter	6.25 Inches	Depth to Water	5 Feet

Graphic Log	Description	Depth	Sample	OVA (ppm)	Blow Counts	Completion
	CONCRETE					
	gravel backfill					
	lean clay w/sand, PL=17, PI=19, LL=36, pH=7.2 S.U., sp.gr.=2.74, moisture content=22.1%	5				
	yellowish brown sandy clay loam					
	sandy lean clay, PI=17, PI=9, LL=26, pH=7.0 S.U., sp.gr.=2.76, moisture content=22.3%	10				
		15				
		20				
		25				
		30				
		35				

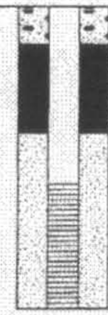


FIGURE 8

MW-5

Project Number	CC121397-45	Drill Rig	CME MODEL 45C
Geologist	DENNIS SMALLEY	Ground Elevation	883.91 Feet
Date Drilled	12-13-97	Total Depth of Borehole	20.7 Feet
Borehole Diameter	6.25 Inches	Depth to Water	6 Feet

Graphic Log	Description	Depth	Sample	OVA (ppm)	Blow Counts	Completion
	topsoil			3		
	yellowish brown, lean clay w/sand, PL=18, LL=28, PI=10, pH=6.6 S.U., sp.gr.=2.76, moisture content=20.3%, moist, coarse fragments.	5		3		
				4		
	silt, non-plastic, pH=7.0 S.U., sp.gr.=2.77, moisture content=30.3%, permeability= 4.1e-6. Shelby tube (8-10 feet BSG)			20		
	yellowish brown, lean clay w/sand	10		ND		
				ND		
	dark gray, sandy silty clay, PL=15, LL= 22, PI=7, pH=7.7 S.U., sp.gr.=2.73, permeability=4.5e-8	15		ND		
	gray, sandy silty clay, PL=15, PI=7, LL=23, pH=7.3 S.U., sp.gr.=2.75, moisture content=12.3%.			ND		
	dark gray, till, coarse LS fragment	20		ND		
				ND		
		25				
		30				
		35				

FIGURE 9

MW-6

Geologist	DENNIS SMALLEY	Ground Elevation	884.10 Feet
Date Drilled	12-13-97	Total Depth of Borehole	12.4 Feet
Borehole Diameter	6.25 Inches	Depth to Water	5 Feet

Graphic Log	Description	Depth	Sample	OVA (ppm)	Blow Counts	Completio
	topsoil					
	yellowish brown, lean clay w/sand. PL=18. LL=28. PI=10. pH=6.6 S.U., sp.gr.=2.76. moisture content=20.3%. moist. coarse fragments.	5				
	silt, non-plastic, pH=7.0 S.U., sp.gr.=2.77, moisture content=30.3%. permeability= 4.1e-6. Shelby tube (8-10 feet BSG)					
	yellowish brown, lean clay w/sand	10				
		15				
		20				
		25				
		30				
		35				

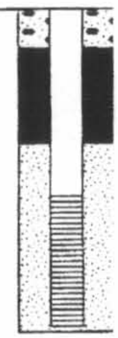


FIGURE 10

SB-17

ENVIRONMENTAL SOIL BORE LOG

Smalley & Associates, Inc.
Environmental Consultants

Date Drilled: 8/27/98		Bore ID:	SB-17
Auger Diam: 2"		Split Spoon Diam:	3/4"
SWL when drilled:	---	Water Sampled?	Yes **No**
Hammer Weight: N/A		Hammer Drop:	N/A
Drill Rig: SIMCO DIRECT PUSH	Site: Custom Cartons	Logged By:	N. Wanner

Depth	Description	PID VOC (ppm)
		0
	Brown Clay Loam - moist	0
	gray till clay	1
5	gray-brown till caly	0
	small gravel lens at 7'10" (~3/8")	
	brown (slightly gray) till clay	1
	brown gray till clay	
10		1
	brown-gray till clay w/ minor gravel	0
	gray till clay w/ minor gravel	2
15	gray and brown till clay w/ tinge purple - minor gravel	2
	gray till clay w/ minor gravel	
	gray till clay w/ min. gravel, trace sand	4
20	gray till clay w/ minor gravel and sandstone fragments	2
	wet till clay	
	lt. gray sand & dk blue/gray gravel	9
	dk. gray sand & gravel - moist	7
25	wet gray sand and gravel	10
	gravel and sand - wet	–
30	sand and gravel - trace silt - wet	–
	sand w/ some gravel - wet	–

TOTAL DEPTH = 32 FEET

FIGURE 11

1,1 DICHLOROETHANE

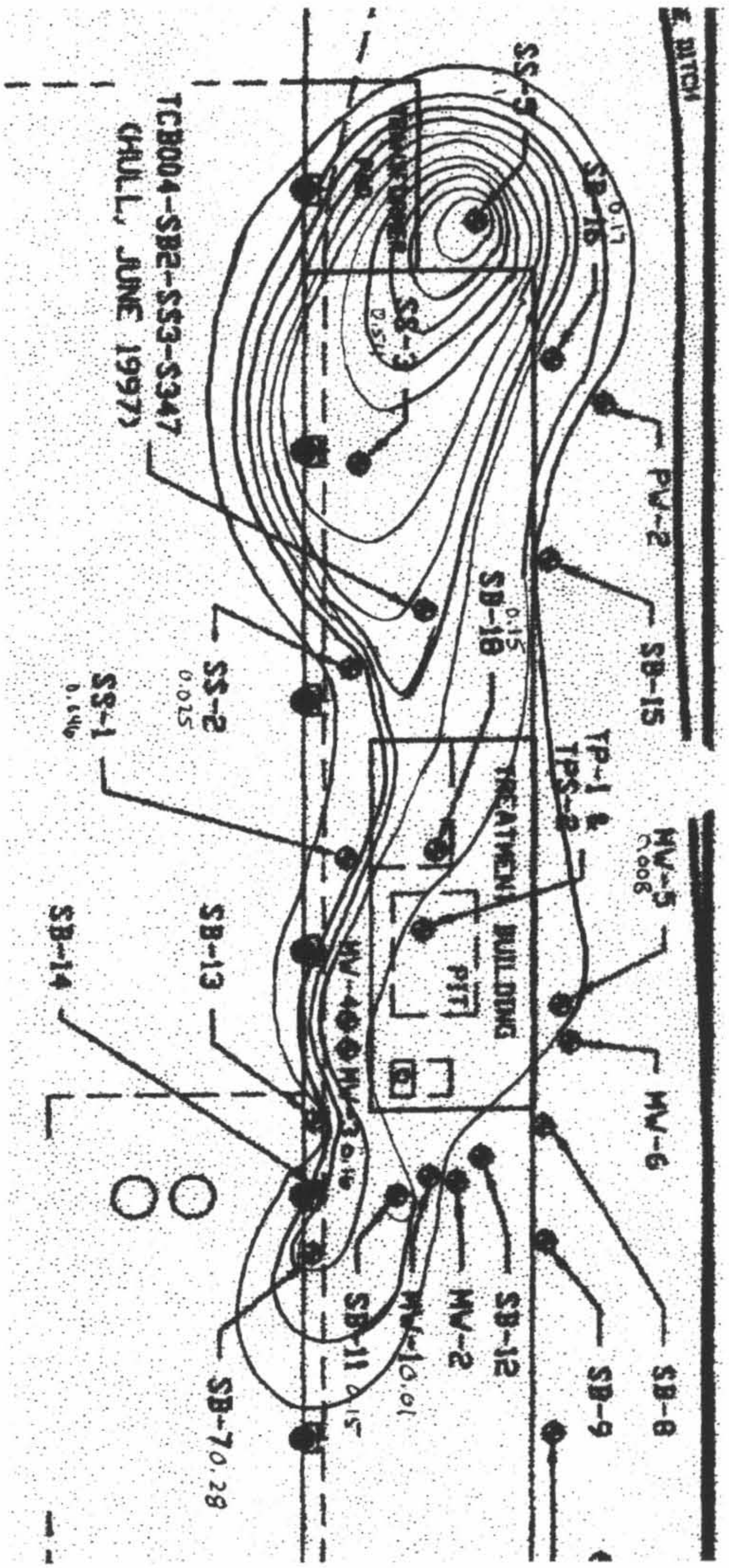


FIGURE 12

1,1,1 TRICHLOROETHANE

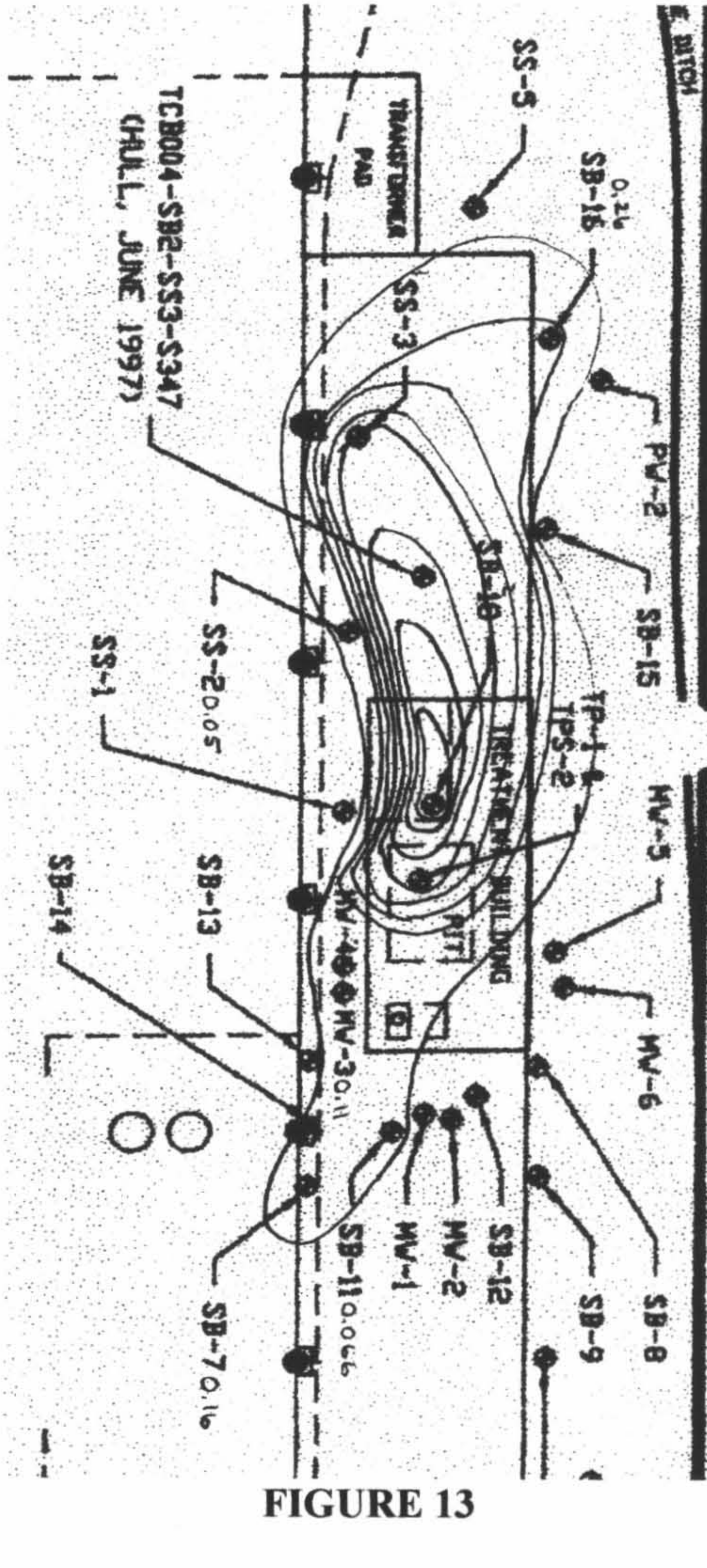
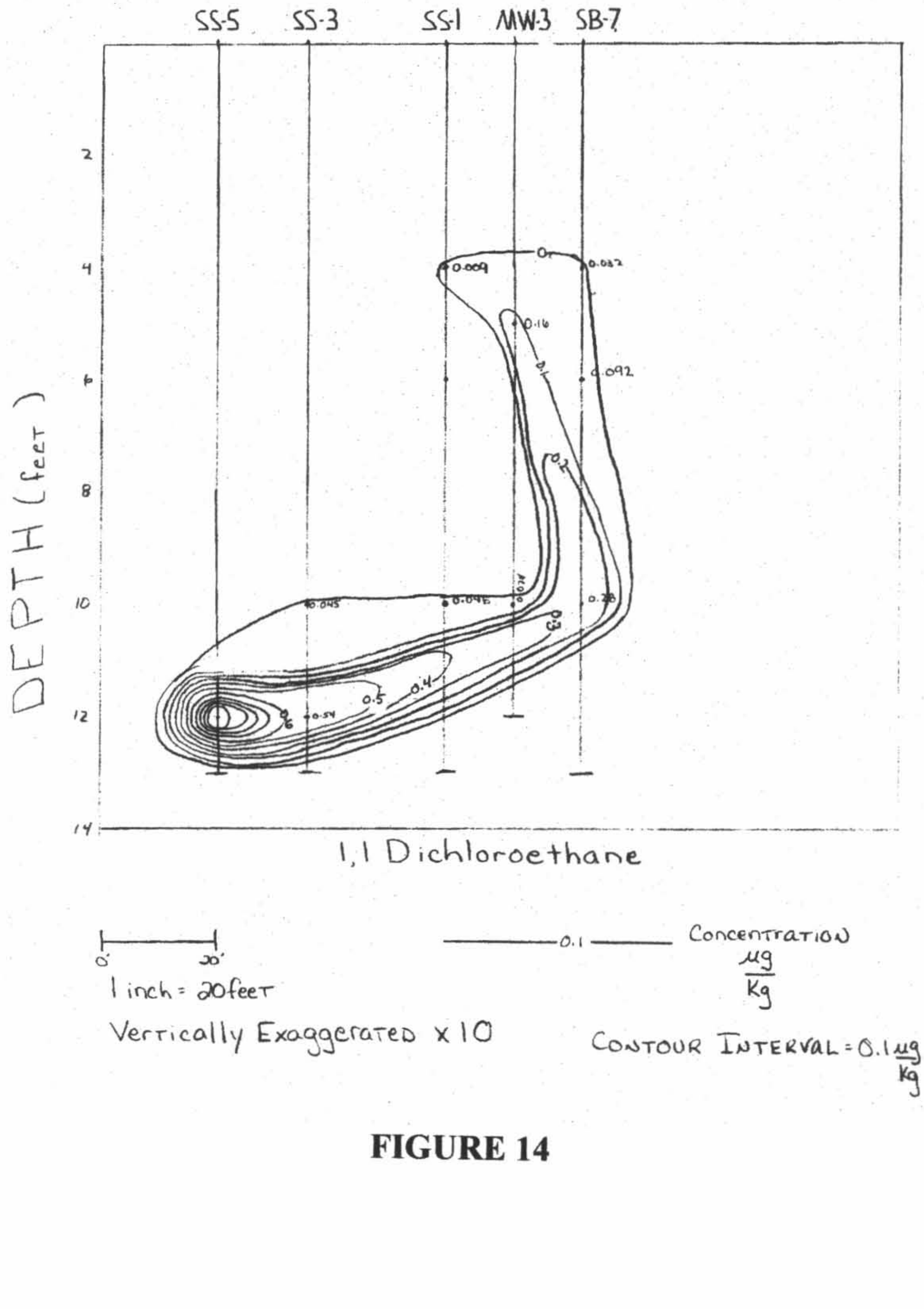


FIGURE 13



SS-5
SS-3
SS-1
MW-3
SB-7
DEPTH (feet)
2
4
6
8
10
12
14
0.009
0.032
0.16
0.092
0.045
0.046
0.28
0.54
1,1 Dichloroethane
0'
20'
1 inch = 20feet
Vertically Exaggerated x 10
0.1
Concentration µg/Kg
Contour Interval = 0.1 µg/Kg

FIGURE 14

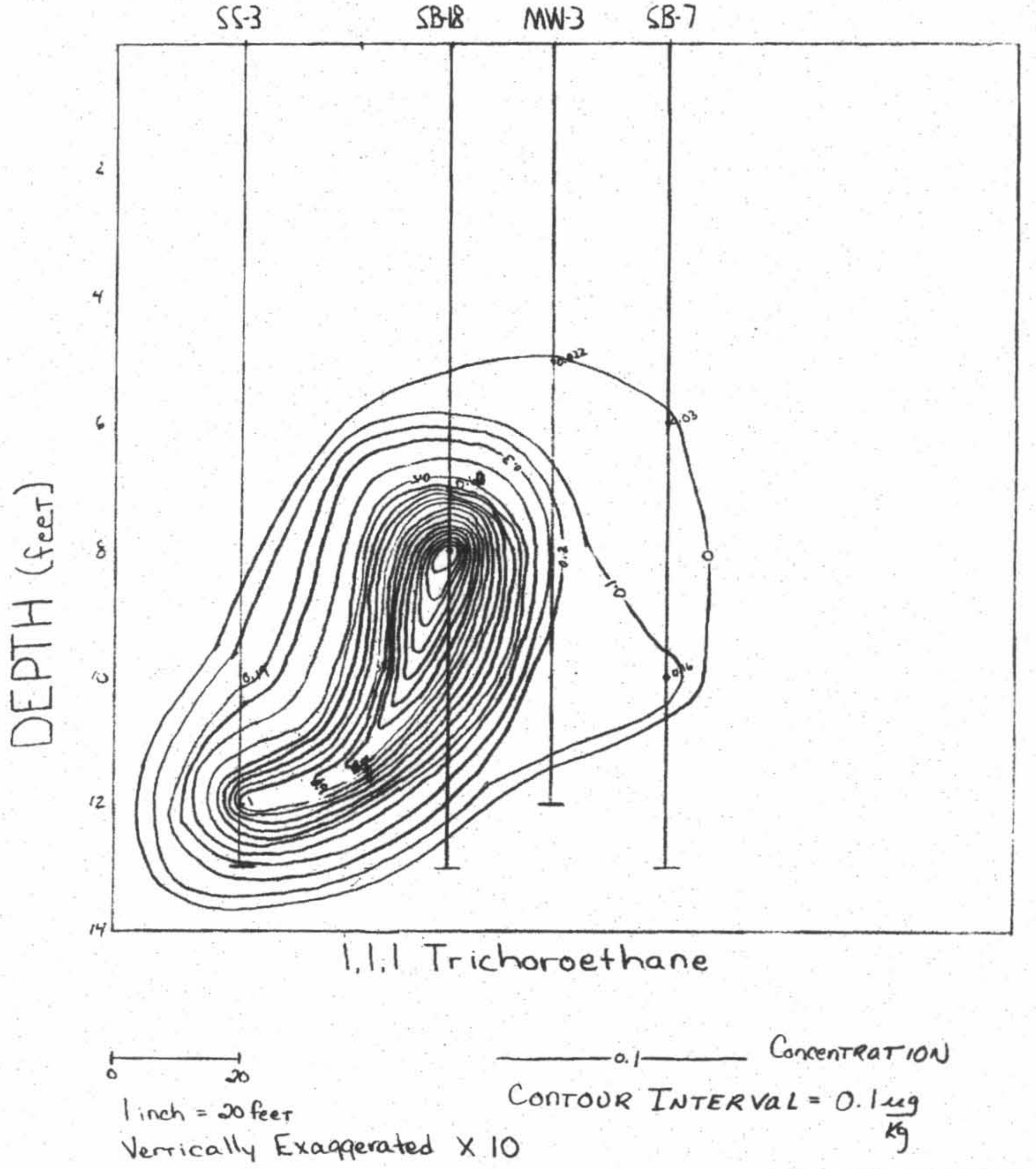

SS-3
SB-18
MW-3
SB-7
DEPTH (feet)
2
4
6
8
10
12
14
1,1,1 Trichoroethane
0
20
1 inch = 20 feet
Vertically Exaggerated X 10
0.1
Concentration
Contour Interval = 0.1 ug/Kg

FIGURE 15

7. REFERENCES

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